PVP 12

Code: EE5T2

III B.Tech - I Semester – Regular Examinations - November 2015

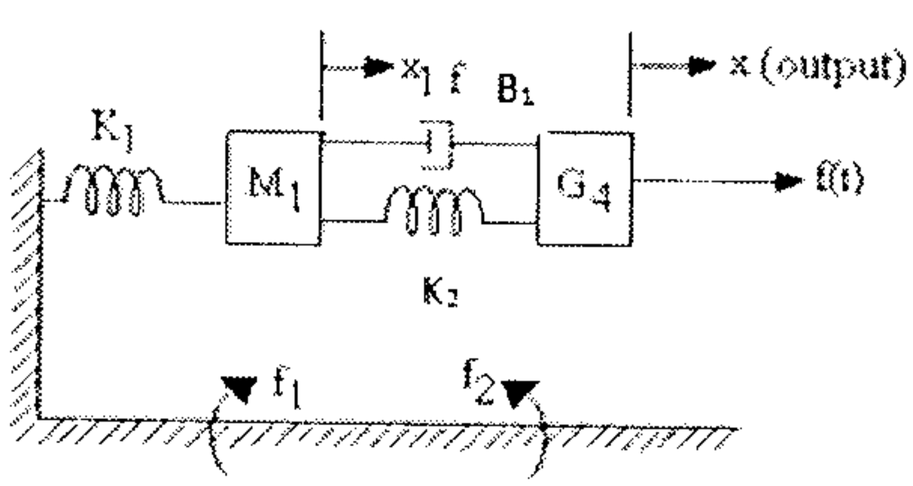
CONTROL SYSTEMS
(ELECTRICAL & ELECTRONICS ENGINEERING)

Duration: 3 hours Max. Marks: 70

Answer any FIVE questions. All questions carry equal marks

1. a) What is a mathematical model of a physical system? Explain briefly. 7 M

b) Derive the transfer function of the mechanical system shown in figure below. 7 M



2. a) Derive the Transfer Function for the armature controlled DC servomotor and develop its block diagram. 7 M

b) Distinguish between AC servomotor and DC servomotor. 7 M

3. The open-loop transfer function of a servo system with unity feedback is $G(S)=\frac{10}{S(0.1S+1)}$. Evaluate the static error constants (Kp, Kv, Ka) for the system. Obtain the steady-

state error of the system when subjected to an input given by the polynomial $r(t) = a_0 + a_1 t + \frac{a_2}{2} t^2$. 14 M

4. a) Obtain the solution of a system whose state model is given by $\dot{X} = A\,X(t) + B\,U(t)$; $X(0) = X_0$ and hence define state Transition matrix. 7 M

b) Obtain the transfer function of a control system whose state model is 7 M

$$\dot{X}(t) = Ax(t) + Bu(t) \qquad Y(t) = Cx(t)$$

Where $A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & -1 & 1 \\ 0 & -1 & -10 \end{bmatrix}$ $B = \begin{bmatrix} 0 \\ 0 \\ 10 \end{bmatrix}$ $C = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix}$

5. a) The open-loop transfer function of a unity feedback control system is given by $G(S) = \frac{K}{(S+2)(S+4)(S^2+6S+25)}$. By applying the Routh criterion, discuss the stability of the closed-loop system as a function of K. Determine the values of K, which will cause sustained oscillations in the closed-loop system. What are the corresponding oscillation frequencies? 7 M

b) By a step by step procedure draw the root locus diagram for a unity negative Feed-back system with open loop transfer-function $G(S) = \frac{K(S+1)}{S^2(S+9)}$. Mark all the salient points

on the diagram. Is the system stable for all the values of K? 7 M

6. a) Sketch the polar plot of a unity feed- back system with open loop transfer function $G(S)=\frac{1}{S(1+S)^2}$. Also find the frequency at which |G(jW)| =1 and the corresponding phase angle G(jW) . 7 M

b) Determine the stability of the system whose open loop transfer function $G(S)H(S)=\frac{1}{S(1+2S)(1+S)}$. Also find gain and phase margin (using Nyquist plot). 7 M

7. Draw the exact Bode Plots and find the gain margin and phase margin of a system represented by
$G(S)H(S)=\frac{10(S+1)}{S(S+0.05)(S+3)(S+5)}$. 14 M

8. Explain the procedure to design the lead-lag compensator in frequency domain. 14 M